Safe, long-term underground geologic storage (sequestration) of CO_2 requires that it be conducted properly. This means thorough planning and geologic analysis of the storage site, safe operating practices and careful monitoring of the underground CO_2 during injection, and continued monitoring for some time afterward.

Reliable geological surveys can prove the presence of impermeable rock barriers and the capability of deep rock formations to hold fluids. Geologic storage will use established techniques and equipment used over many years by industry, although more advanced technologies designed specifically for CO_2 injection are also being developed.

Rock samples from potential storage sites are used to analyze the rocks and the properties that affect the safety and security of storage.

Storage sites will be monitored so that any undesirable CO_2 movement can be readily detected and fixed.

Specially-designed devices can monitor any changes in air quality or underground water quality due to the presence of CO_2. Similarly, monitoring techniques such as seismic imaging can monitor the location and conditions of the CO_2 underground.

Geologic storage of CO_2 can be a vital part of the solution to the problem of global climate change. Methods and technologies are developing rapidly, as are the legal frameworks to regulate them. Geologic storage projects undertaken over the next ten years will be critical for demonstrating CO_2 storage in diverse geologic settings and will establish the basis for widespread global application.

For More Information

The best assurance of safe and secure geologic storage is a project that is well designed and conducted properly and carefully. More detailed explanations, including questions to ask about proposed projects to ensure that they are being conducted properly, can be found in the booklet, "Geologic Storage of Carbon Dioxide: Staying Safely Underground."

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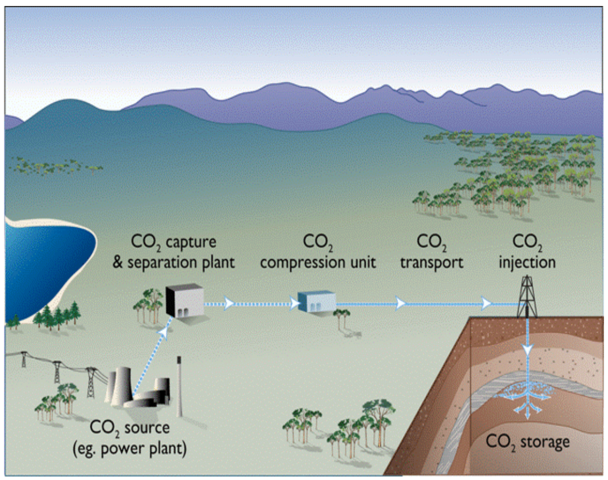
Geologic Storage of Carbon Dioxide

STAYING SAFELY UNDERGROUND

GEOLOGIC STORAGE OF CARBON DIOXIDE: STAYING SAFELY UNDERGROUND

Carbon dioxide (CO_2) is a natural substance in the air vital to life. It is widely used for many purposes from carbonating drinks to filling fire extinguishers. As a greenhouse gas, its presence in the atmosphere traps heat from the sun. Normally, this keeps the climate warm enough for life to continue. However, the burning of fossil fuels is increasing CO_2 levels in the atmosphere above naturally-occurring levels, contributing to global climate change.

Geologic storage of CO_2 is the underground disposal of CO_2 from large industrial sources such as power plants. Carbon Capture and Storage (CCS), also known as Carbon Capture and Sequestration, includes geologic storage as one of its components.

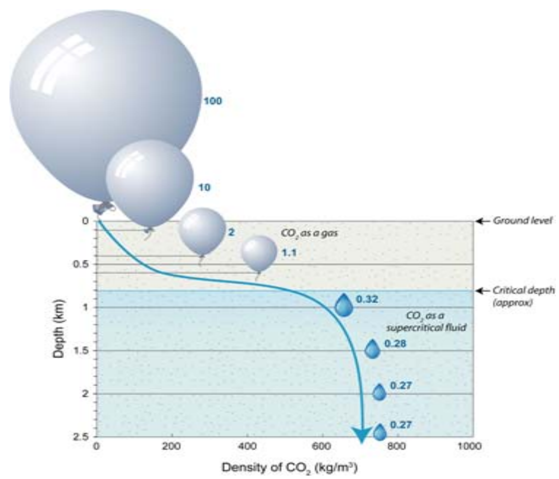


In CCS, CO_2 is captured before it can be emitted into the atmosphere. It is then compressed into a dense fluid, transported to the injection site and disposed of underground in suitable rock formations.

CCS is one tool—along with energy efficiency, fuel switching and renewable energy sources—essential to reducing CO_2 levels. Many studies show that by far the most effective and least-costly way to reduce CO_2 levels to avoid climate change is to use all CO_2 reduction tools, including CCS.

Geologic storage projects have already successfully stored millions of tons of CO_2 without detectable leakage, some for many years. For example, the Sleipner Project in Norway has injected over 10 million tons of CO_2 with no leakage. Similarly, the IEA GHG Weyburn-Midale CO_2 Storage and Monitoring Project in Canada has injected over 5 million tons of CO_2 into a depleted oil field. Extensive monitoring by an international team of scientists has detected no leakage. Many new projects are planned in the years to come.

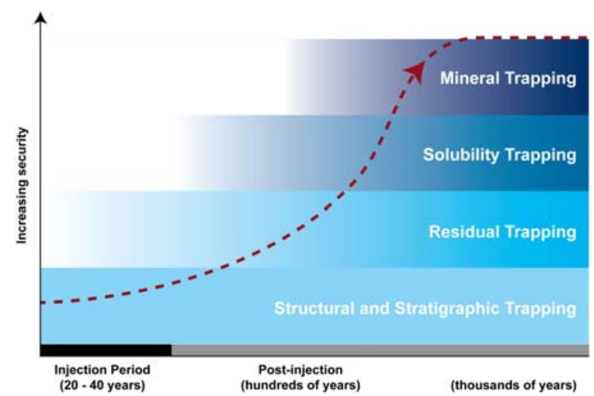
In geologic storage, CO_2 is injected under high pressure into deep, stable rocks in which there are countless, tiny pores that trap natural fluids. Some types of rock formations have securely trapped fluids, including CO_2, for long periods, even millions of years. The CO_2 will be injected into these types of formations.



CO_2 will be injected at depths below 0.8 km (2600 feet). CO_2 increases in density with depth and becomes a supercritical fluid below 0.8 km. Supercritical fluids take up less space and diffuse better than either gases or ordinary liquids through storage rocks. The blue numbers show the volume of CO_2 at each depth compared to the volume of 100 at the surface.

Several types of rock formations are suitable for CO_2 storage. These include depleted oil and gas reservoirs, deep saline formations and deep, unmineable coal seams. Deep, porous rock formations with trapped natural fluids such as oil, natural gas or highly salty and unusable water are common throughout the world. Geologists have found that these formations have the capacity to securely hold vast amounts of CO_2, potentially equivalent to hundreds of years of man-made emissions.

The same geologic forces that kept the original fluids in place will also secure the liquid CO_2. Once injected, it will be far below the surface and separated from usable groundwater by thick, impermeable barriers of dense rock. This is either structural or stratigraphic trapping depending on the geology. In residual trapping, CO_2 is trapped in tiny pores within the storage rocks. Over time, the liquid CO_2 will dissolve in water already in the rock formation and then may combine chemically with minerals in the rocks to trap it even more securely.



As time goes on, increasingly secure trapping mechanisms come into play and the overall security of storage increases.